



# Scanning SQUID Microscope for Studying Vortex Matter in Type-II Superconductors (Springer Theses)

*Amit Finkler*

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Common methods of local magnetic imaging display either a high spatial resolution and relatively poor field sensitivity (MFM, Lorentz microscopy), or a relatively high field sensitivity but limited spatial resolution (scanning SQUID microscopy). Since the magnetic field of a nanoparticle or nanostructure decays rapidly with distance from the structure, the achievable spatial resolution is ultimately limited by the probe-sample separation. This thesis presents a novel method for fabricating the smallest superconducting quantum interference device (SQUID) that resides on the apex of a very sharp tip. The nanoSQUID-on-tip displays a characteristic size down to 100 nm and a field sensitivity of  $10^{-3}$  Gauss/Hz<sup>(1/2)</sup>. A scanning SQUID microscope was constructed by gluing the nanoSQUID-on-tip to a quartz tuning-fork. This enabled the nanoSQUID to be scanned within nanometers of the sample surface, providing simultaneous images of sample topography and the magnetic field distribution. This microscope represents a significant improvement over the existing scanning SQUID techniques and is expected to be able to image the spin of a single electron.



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